LA-UR-21-21736
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Title: Autonomous Optimization for Pulsed Neutron Generators (PNGs)

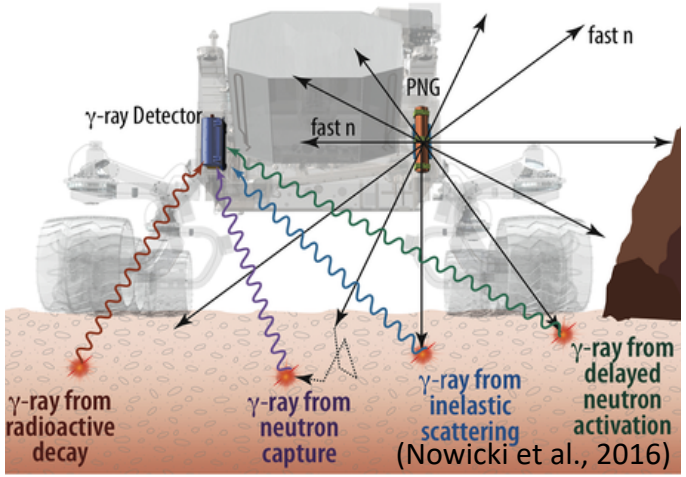
Author(s): Pinilla-Orjuela, Maria Isabel

Intended for: DisrupTECH Lightning Talk

Issued: 2021-02-23

AUTONOMOUS OPTIMIZATION FOR PULSED NEUTRON GENERATORS (PNGs)

MARIA PINILLA-ORJUELA, ISR-1, 316-841-2327, MPINILLA@LANL.GOV



(Nowicki et al., 2016)

THE PROBLEM

The optimization of PNG systems is very industry specific, time consuming, labor intensive, and uninformed by real-time data.

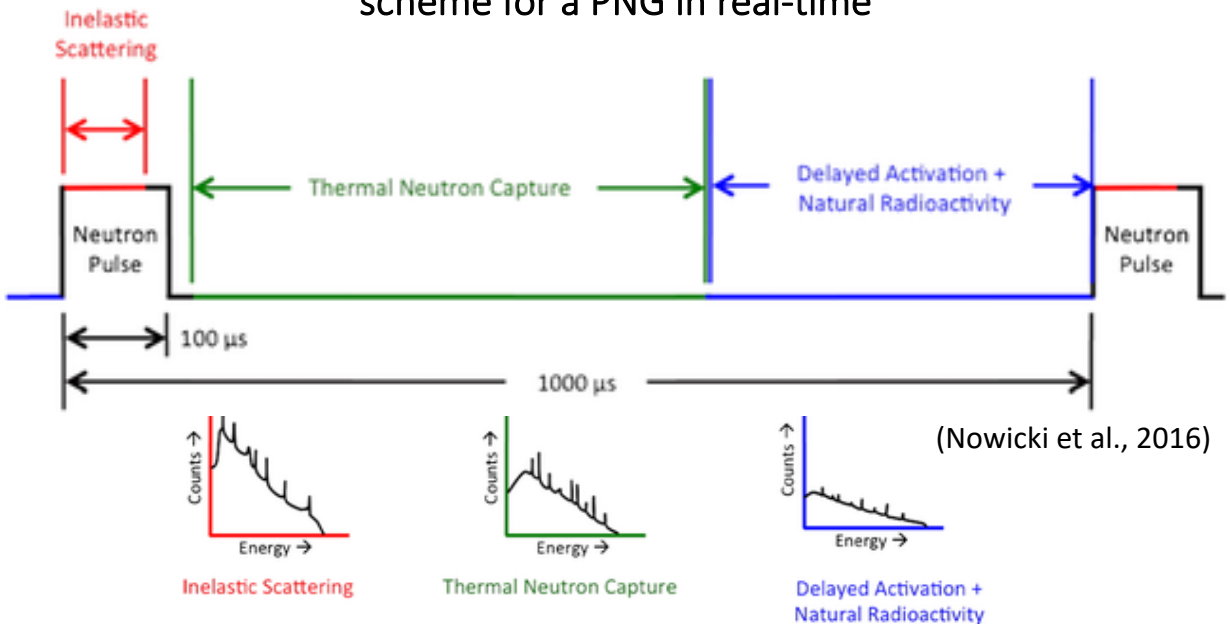
APPLICATION

The algorithm will benefit industries that require high-fidelity inspection of material composition, neutron imaging, and isotope production:

- **Automotive and parts manufacturing:** neutron radiography, engine diagnostics, product quality inspection, corrosion detection
- **Construction and structural diagnostics:** inspect integrity of bridges/structures, quality control of concrete mix
- **Nuclear safeguards/nonproliferation:** nuclear fuel scanning, screening and detection of special nuclear materials
- **Oil well logging and planetary exploration:** detection of oil, water, and other raw materials
- **Medical:** eliminates the need for a research reactor to produce medical isotopes

THE SOLUTION

A Machine Learning algorithm to dynamically optimize the timing scheme for a PNG in real-time



(Nowicki et al., 2016)

- We use **computer modeling and simulation** to generate large amounts of training data
- Experimental **field measurements** are used to **validate** computer models and simulations
- A **machine learning algorithm** is trained using training data to determine the optimal timing scheme of the PNG
- The PNG **pulse width and pulse period is updated** in real time, even as conditions change
- Optimized settings **reduce operation time, improve accuracy, and reduce the wear and tear of the PNG**

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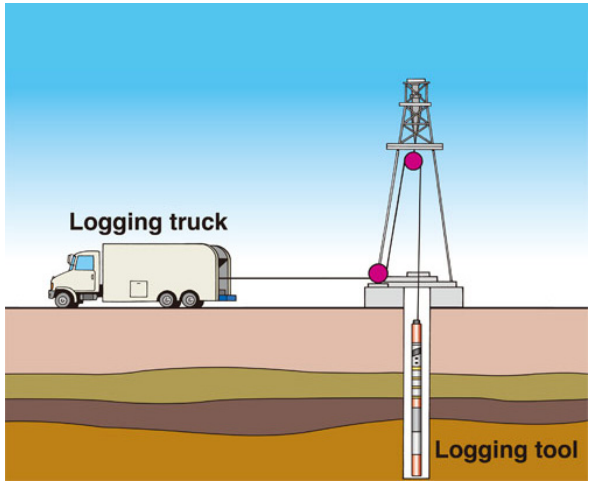


BENEFITS

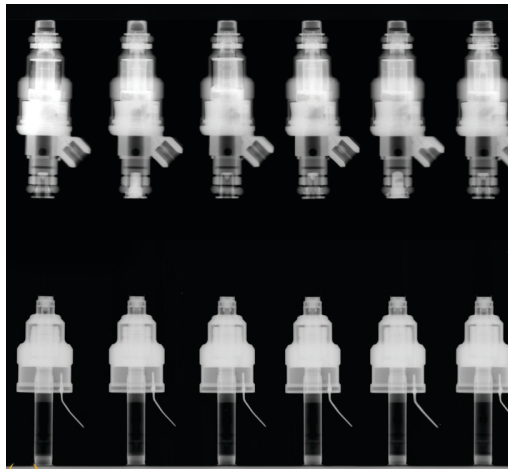
Our algorithm will:

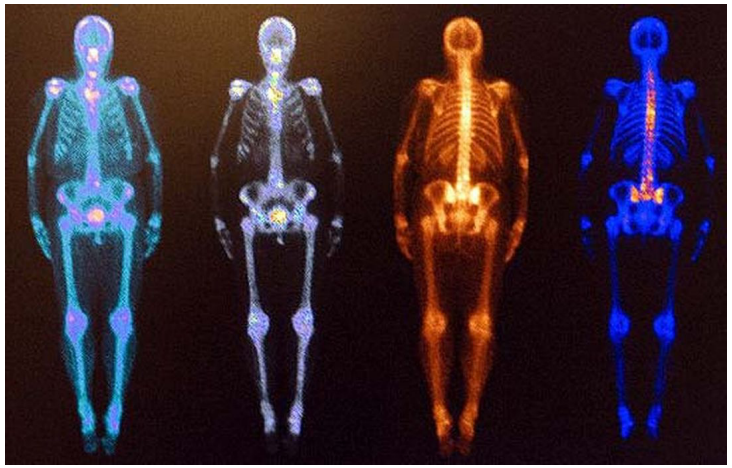
- Reduce time and cost of operation
- Produce faster and more accurate results
- Introduce flexibility in dynamic conditions
- Increase the lifetime of the PNG
- Expand isotope detection capabilities

OUR COMPETIVE ADVANTAGE

The optimization of PNG systems is very **industry specific** and is **very costly** in terms of **time and effort** to achieve. This task is currently delegated to the user, who must use up resources to optimize the system without real-time data.

We propose using the power of **machine learning** to fix this problem and provide the end user a **real-time**, **streamlined**, and **flexible** way to **optimize** their system while **minimizing** the **time, money, and resources spent** to set up and operate their PNGs.





OUR TECHNOLOGY STATUS AND NEXT STEP

- Current efforts are geared towards using computer modeling and simulations to provide a proof of concept
- Expedition to the artic this summer will generate experimental data to validate simulations and test algorithm

2020	2021	2022	2023	2024
Conduct simulations to generate test data	Validate simulations and test ML algorithm	Algorithm optimization and software development	Construction of prototype and field testing	Industry partner and software licensing

TECHNOLOGY READINESS LEVEL AND IP

TRL 2: Training data has been simulated for algorithm development. Machine learning algorithm under construction. Experimental data for simulation validation will be completed at the end of the summer 2021.